

## **TITLE OF THE INVENTION**

### **DEVICE AND METHOD FOR EVALUATING VOCAL PERFORMANCE**

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## **FIELD OF THE INVENTION**

The present relation relates to a device and a method for evaluating vocal performance, destined to evaluate various aspects of a singer's performance in comparison to a reference voice; to provide the singer, during the evaluation, with visual indication of how to improve his/her performance; and to present, at the end of the evaluation, a general report on the singer's performance, which shall include a summary of his/her performance to each aspect and a final general result.

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## **BACKGROUND OF THE INVENTION**

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The device in question was developed modularly, in order that it allows the insertion or removal of aspects to be evaluated, and in a scaleable way, so as it may be used in systems with different computational resources available for the execution of the evaluation.

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The device object hereof was developed to be used specifically, but not exclusively, in electronic systems equipped with the function of vocal substitution in songs, widely known as *karaoke*.

As known, the system of vocal substitution in songs (*karaoke*) basically operates by removing from the song the audio signal correspondent to the reference voice, which will be substituted by inserting the audio signal correspondent to the singer's voice.

Figure 1 attached hereto demonstrates a block diagram of an equipment incorporating an

usual system of voice substitution (or *karaoke*) (I). As illustrated in said block diagram, a original song is an audio signal originated from an audio source (1), which may be a DVD, CD, a memory, or any other source. The system (I) foresees the removal (2) of the voice signal from the original song, which is made through algorithms or adequate filters, depending on the type  
5 (analogical or digital) and on the codification of the audio signal. Said system (I) also foresees the inclusion (3) of the singer's voice signal [originated from a microphone (4), for instance], which is made through a mixing procedure (or mixture), or through simultaneous and synchronized reproduction of the accompaniment and voice of the singer.

In order to improve the capacity of entertainment of these usual systems for vocal  
10 substitution (or *karaoke*), the singer generally receives a score for his/her performance at the end of the song.

Various examples of *karaoke* apparatus with function of calculation of score are broadly known. One of them consists in the object of patent US 5,557,056, wherein the score is calculated by comparing the volume of the song's accompaniment signal and the volume of the  
15 singer's voice signal. Patent US 5,719,344 also foresees a method to provide a score based on the measurement of the reference voice signal and the singer's voice signal.

Patent US 6,326,536 foresees a method for the calculation of score based on the volume measured of the reference voice and the singer's voice, proposed to computational systems with low processing capacity.

20 More recently, improvements have been proposed in order to increase the entertainment of users, such as the competition system included in patent US 6,352,432. In this patent, various singers may sing simultaneously the same song, obtaining information of superiority/inferiority

of a singer in relation to the others while singing. This same information is submitted in the form of images that represent a contest between animated characters. This equipment uses information of tone, rhythm, and volume.

Patent US 5,750,912 proposes the alteration of the singer's voice according to the original song by using information of tone, so as it reproduces a performance better than the original.

Patent US 5,804,752, on its turn, proposes a method for attributing individual scores to two singers singing in duet.

Various deficiencies have been observed in the solutions proposed. First of all, the devices proposing the evaluation of determined aspects of the singer's performance require high amount of computational resources, which makes the product expensive. On the other hand, the devices that may be used under limited computational resources fail due to the evaluation of the volume only, which is extremely dependent on the equipment and respective accessories, especially the microphone, and not intrinsically related to the singer's performance.

The devices of evaluation proposed also fail when providing the result only at the end of the song. And when these devices evaluate the singer's performance in more than one aspect, they do not present the results individually, which impedes the singer from having tips of how to improve his/her performance in each individual aspect.

Thus, none of the solutions proposed provides the singer with detailed information on his/her performance while singing, which would allow him/her to improve the performance during the song, nor information at the end of the song of how the singer could improve his/her performance for next time.

The sole apparent exception is the system proposed in patent US 6,352,432 mentioned

above. However, this system indicates only if the singer's performance is better or worse than another singer competing with him/her, not indicating how the singer could improve his/her performance.

In summary, there is not an evaluating device that may be used both in equipment with low level of computational resources available and in equipment with high level of computational resources and, therefore, more expensive, that provides the evaluation of each aspect of the singer independently, during and at the end of the song, in order to guide the singer concerning his/her performance and allowing the easy inclusion and removal of the aspects evaluated.

### **SUMMARY AND OBJECTS OF THE INVENTION**

Aiming to provide an evaluating device that integrates all these characteristics and that would consequently eliminate the deficiencies in the evaluating devices known, this device and method for evaluating vocal performance is created to be used in various types of systems and environments, not limited to specific sections of the *karaoke* market, nor to this market only, but also to other equipment, including the use by professional singers. The device invented herein further provides an evaluation with quality superior to the best evaluating devices currently available on the market, due to the utilization of a adequateness and calibration method of said evaluation.

The main aspects in which the sound description is based generally are:

- Melody (or tone): sequence of the fundamental frequencies of each note;
- Rhythm: sequence of duration of each note;

- Timbre: spectral compound of each note;
- Harmony: combination of two or more notes played simultaneously.

Satisfactory results of evaluation may be obtained by using melody, rhythm, and volume of voice signals, considering that the device object hereof allow the use of any sets of aspects.

5           The device object hereof foresees the characteristics of modularity, which allows the addition, removal, or modification of the aspects (modules) of evaluation, and of scale, which allow the redefinition of the aspects to be evaluated and the re-dimensioning of the resources necessary for processing the singer's voice and the reference voice. Then, the incorporation of the evaluating device proposed herein to various systems is possible, such as processor attached to  
10   DVD equipment (regardless of the platform used), in digital signal processors (DSP), or in other platforms, whether as software or hardware. Thus, the device in question allows an adequateness of the quality of evaluation to the computational resources available.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

15           A more complete appreciation of the present invention and many of the attendant advantages thereof will be readily understood by reference to the following detailed description when taken in conjunction with the accompanying drawings, in which:

Figure 1       is a block diagram of equipment incorporating an usual system of voice  
20               substitution according to the state of the art;

Figure 2       is a block diagram of equipment that incorporates a system of vocal substitution

and an evaluating device according to the invention.

### **DETAILED DESCRIPTION OF THE INVENTION**

Figure 2 attached hereto demonstrates a block diagram of an equipment that incorporates  
5 an usual system of vocal substitution (which may be a *karaoke*), such as the one illustrated in  
Figure 1, however incorporating the evaluating device object of this invention (II).

As illustrated in said block diagram, the original song is an audio signal originated from  
an audio source (1), which may be a DVD, CD, a memory, or any other source. The system (I)  
foresees the removal (2) of the reference signal, and the inclusion (3) of the singer's voice signal  
10 [from a microphone, for instance (4)].

As illustrated in the same block diagram, the evaluating device invented herein (II)  
receives, as input, the signal of the reference voice removed from the original song originated in  
the source (1), from which the accompaniment (5) is removed, as well as the singer's voice signal  
obtained, for instance, from the audio signal generated by the microphone (4). The evaluation is  
15 carried out by processing (6) the signals received as entry. The adequateness of said processing to  
the computational resources available and the calibration of the results of the evaluation are  
carried out whenever the device is modified or transported to new platforms by an adequateness  
and calibration method (7), which uses information of calibration originated from the results of  
the evaluation of a heterogeneous group of human evaluators, and from the results of the  
20 evaluation of the device for the same set of singing executions. The result of the evaluation is  
submitted to the user interface device (8), which generates visual and auditory feedback during  
the execution of the song, providing information on the various evaluated aspects, and, at the end

of the song, a visual and auditory evaluation representing the general performance of the singer evaluated and the performance in relation to each one of the aspects evaluated.

The device of visual feedback uses icons, sentences, and sounds to provide the singer with instantaneous and individual evaluation of each aspect during the song, in order to indicate the singer how he/she may improve the performance.

In order to guarantee the quality of the result of the evaluation, a data base of evaluation was prepared through the realization of field tests with a significant number of volunteer evaluators. The tests consisted in recording the singer performance of a heterogeneous group of singers and in registering, by each volunteer evaluator, the evaluation of performance of the respective singer. After all evaluations are complete, they were tabulated and used as a calibration standards of the global evaluation of the singer supplied by the device.

Concerning the modular and scalar characteristic of the device invented herein, and in order to allow its easy adaptation and portability, the evaluating device in question presents the following characteristics:

- The device foresees the standardization of the interface in the implementation of the evaluation of each aspect, allowing the addition, removal, and/or modification of a determined aspect. Additionally, the processing of inputs may be defined based on the relation between the quality of its results and the quantity of computational resources consumed thereby.

- The device further foresees the standardization of the interface in the implementation of the acquisition of samples. This allows any combination of reference channels and evaluated channels to be implemented with minimum effort.

- The device foresees the parameterization of the acquisition of samples. Thus, to each

reference channel or to each evaluated channel, the alteration in the sampling rate and other parameters related to the acquisition may be carried out with minimum effort. This is important to the portability, since the parameters of acquisition depend on the apparatus wherein the device is built in.

5           - Finally, the device foresees the simplification of its interface as a whole, through the standardization of the entry and exit devices. Thus, the task of building the device in a determined apparatus involves few alterations in the original system.

Once the processing is defined in order to adequate the device to the quantity of computational resources available, the calibration of the device for the maximization of the  
10   evaluating quality is made through the optimization of the similarity of the results collected from the evaluation of performance of an heterogeneous group of singers by an heterogeneous group of human evaluators, and from the results collected from the evaluation of the same executions in the same group of singers by the evaluating device invented herein (with the limitations of resources applicable). The more computational resources are available, the better will be the  
15   evaluations. The scalar characteristic allows that these resources may be used on an improved manner, supplying an evaluation of quality superior to those known, due to the set of resources available.

The advantages of the implementation of the device invented herein are: possibility of solution of additional hardware components with zero cost, in case of implementation of the  
20   device in software; large flexibility, allowing the development of an evaluating device with more quality than those currently existent in commercial apparatuses, even with limited computational resources; and the possibility of implementation in different platforms.